



Hochschule
Zittau/Görlitz
UNIVERSITY OF APPLIED SCIENCES



*Diversifikations- und Hedging-
Eigenschaften von Krypto-Assets in
Aktienportfolios*

Mario Straßberger

*12. Jahrestagung des Arbeitskreises Finanzierung
Berlin, 16. Juni 2024*



Agenda

- 1 Introduction
- 2 Data
- 3 Diversification Effects
- 4 Hedging Abilities
- 5 Conclusion and Outlook

Phenomenon cryptocurrencies, esp. Bitcoin: (1) technological vs. (2) economic perspective

- (1) Payment token based on blockchain technology, decentralised and redundantly recorded, not relying on central institution
 - (2) Digital commodity traded on non-institutionalised markets, no currency or money, value is originated by trust in that value
- ⇒ Bitcoin as new, original asset class for investors

More and more institutional agents accept to invest into Bitcoin

- Rising acceptance by private investors
- Regulation attempts by governments, central banks, financial supervisors
- Public extension: futures contracts, effective payment possibilities, ETFs, ...
- Large quantities of money supply at low interest rates until 2022

Research questions: Is Bitcoin a meaningful digital asset?

- ... suitable as portfolio admixture?
- ... effective as a hedge to other assets?

Related literature:

- (1) Technological issues: e.g. Böhme *et al.* (2015), Dwyer (2015), Schinckus (2020)
- (2) Valuation and pricing: e.g. Schilling, Uhlig (2019), Liu *et al.* (2019)
- (3) Market microstructure: e.g. Ghysels, Nguyen (2019), Aleti, Mizrach (2021)

Impacts on portfolio composition?

Dyhrberg (2016), Bouri *et al.* (2017), Fang *et al.* (2018) confirm hedging abilities;
Klein *et al.* (2018) reject hedging capabilities of Bitcoin

Guesmi *et al.* (2019), Trimborn *et al.* (2020), Petukhia *et al.* (2021) affirm positive
diversification impacts

Daily settlement prices of German stock market index DAX (KKMDB)

Daily Euro Bitcoin prices (BTC) close to 5.45 pm MET (Bitcoin.de)

Risk free rates at one-year maturities (Deutsche Bundesbank)

Period from January 2, 2012 until December 30, 2020

Daily discontinuous returns of DAX and BTC prices

$$r_{i,t} = (p_{i,t} - p_{i,t-1})/p_{i,t-1}, \quad i = \text{DAX, BTC}$$

Summary statistics over entire sample:

	<i>n</i>	Mean	Median	STD	SKEW	KURT	CORR
<i>Full sample</i>							
DAX	2,275	0.045%	0.083%	1.237%	-0.461	9.329	
		(11.20%)	(20.69%)	(19.57%)			
BTC	2,275	0.469%	0.235%	3.976%	0.167	8.830	0.1046
		(117.2%)	(58.85%)	(62.87%)			

3 Diversification Effects

Risk averse investors seek for assets improving the risk-return-ratio of their portfolio (Kumar, 2009)

To be independent of assumptions on investors preferences (Elton *et al.*, 2014):

- (1) P of DAX and BTC with same projected standard deviation like pure stock portfolio
- (2) MVP out of efficient DAX-BTC portfolios

Parameter estimates, assessed annually at $t = \text{January, 1}$, based on last n daily return obs.

- DAX and BTC sample mean returns $\bar{r}_{\text{DAX},t}$ and $\bar{r}_{\text{BTC},t}$
- Sample standard deviations of DAX and BTC returns $s_{\text{DAX},t}$ and $s_{\text{BTC},t}$
- Sample correlation coefficient between DAX and BTC returns c_t

Portfolios are held to December, 31, rebuilt at same procedure etc. (no short sale constraints)

3 Diversification Effects

- (1) Calculation of portfolio weights $w_{DAX,P,t}$ at time t by
Equalling projected standard deviation of portfolio return to $s_{DAX,t}$ and solving

$$0 = (s_{DAX,t}^2 + s_{BTC,t}^2 - s_{DAX,t}s_{BTC,t}c_t)w_{DAX,P,t}^2 + (s_{DAX,t}s_{BTC,t}c_t - 2s_{BTC,t}^2)w_{DAX,P,t} + s_{BTC,t}^2 - s_{DAX,t}^2$$

$w_{DAX,P,t}$	$w_{BTC,P,t}$	$\mu_{p,t}$	$\sigma_{p,t}$	$r_{p,t+1}$	$s_{p,t+1}$
<i>2013</i>					
0.7633	0.2367	49.95%	18.76%	122.69%	26.84%
<i>2014</i>					
0.9731	0.0269	34.77%	14.55%	2.33%	16.26%
<i>2015</i>					
0.7236	0.2764	-13.01%	16.68%	21.87%	21.25%
<i>2016</i>					
0.5746	0.4254	27.32%	23.44%	42.59%	18.40%
<i>2017</i>					
0.4509	0.5491	52.45%	20.75%	160.88%	38.11%
<i>2018</i>					
0.9637	0.0363	22.09%	10.58%	-22.16%	15.28%
<i>2019</i>					
0.9288	0.0702	-25.21%	15.46%	28.11%	13.61%
<i>2020</i>					
0.9022	0.0978	29.89%	13.94%	22.12%	31.34%

3 Diversification Effects

- (2) Calculation of portfolio weights $w_{DAX,MVP,t}$ at time t by
Minimising equation (1)

$$w_{DAX,MVP,t} = \frac{-(s_{DAX,t} s_{BTC,t} c_t - 2s_{BTC,t}^2)}{2(s_{DAX,t}^2 + s_{BTC,t}^2 - s_{DAX,t} s_{BTC,t} c_t)}$$

$w_{DAX,MVP,t}$	$w_{BTC,MVP,t}$	$\mu_{MVP,t}$	$\sigma_{MVP,t}$	$r_{MVP,t+1}$	$s_{MVP,t+1}$
<i>2013</i>					
0.8817	0.1183	38.41%	17.75%	73.09%	17.96%
<i>2014</i>					
0.9865	0.0135	29.14%	14.48%	3.16%	16.46%
<i>2015</i>					
0.8618	0.1382	-4.51%	15.45%	16.82%	21.33%
<i>2016</i>					
0.7873	0.2127	19.54%	21.02%	25.63%	17.47%
<i>2017</i>					
0.7255	0.2745	30.56%	17.28%	86.57%	20.57%
<i>2018</i>					
0.9818	0.0182	17.17%	10.50%	-20.52%	15.32%
<i>2019</i>					
0.9649	0.0351	-22.05%	15.28%	25.85%	13.57%
<i>2020</i>					
0.9511	0.0489	26.74%	13.54%	15.48%	31.94%

3 Diversification Effects

Ex post calculation of reward-to-variability-ratio

$$SM_{i,t} = \frac{r_{i,t}^* - r_{f,t-1}}{s_{i,t}^*}, \quad i = \text{DAX, P, MVP},$$

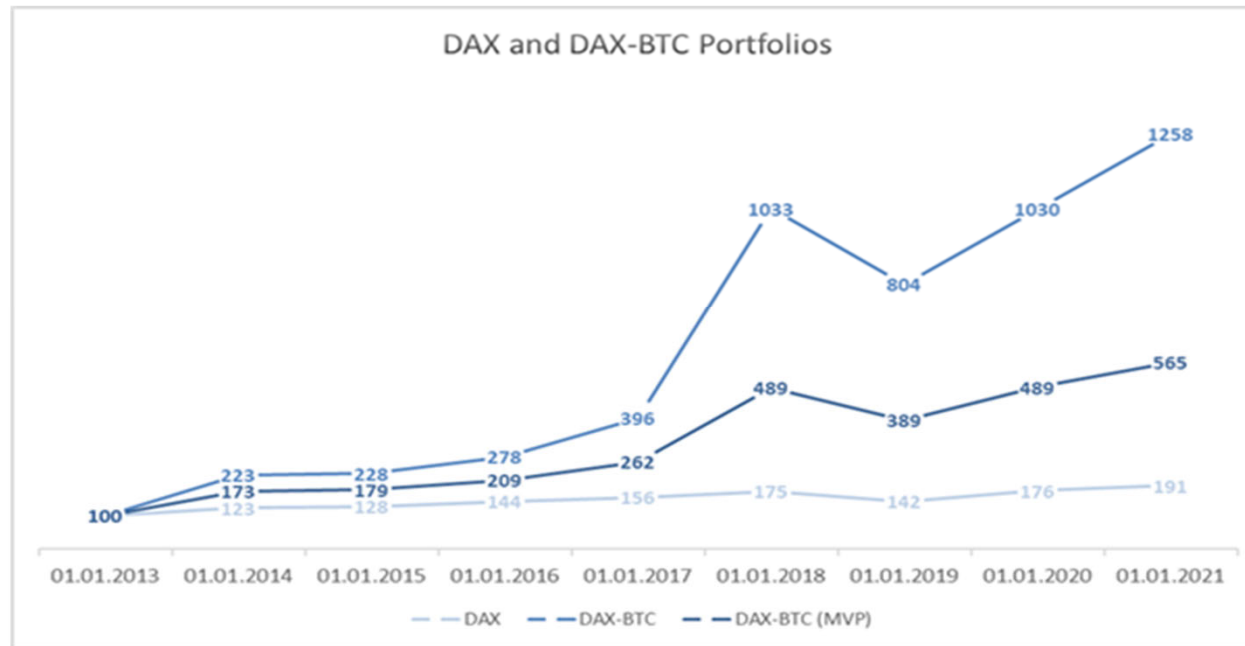
Ex ante evaluation of Value-at-Risk for one-year time horizon and probability level $p = 0.99$

$$VaR_{i,t}(p) = \bar{r}_{i,t} - z_p \cdot s_{i,t} \quad i = \text{DAX, P, MVP}.$$

	$SM_{\text{DAX},t+1}$	$SM_{\text{P},t+1}$	$SM_{\text{MVP},t+1}$	$VaR_{\text{DAX},t}$	$VaR_{\text{P},t}$	$VaR_{\text{MVP},t}$
2013	1.6166	4.5727	4.0718	0.1685	0.0000	0.0293
2014	0.2317	0.1359	0.1845	0.1040	0.0000	0.0461
2015	0.5056	1.0338	0.7927	0.3488	0.5188	0.4050
2016	0.4372	2.3368	1.4899	0.4285	0.2729	0.2943
2017	1.2372	4.2428	4.2478	0.3968	0.0000	0.0970
2018	-1.1763	-1.4046	-1.2938	0.1239	0.0256	0.0730
2019	1.7393	2.1135	1.9535	0.5489	0.6122	0.5764
2020	0.2891	0.7262	0.5049	0.0889	0.0258	0.0480

3 Diversification Effects

Predominant performance of two types of DAX-BTC portfolios



Naive diversification? / Estimation error in portfolio optimisation (DeMiguel *et al.*, 2009)

4 Hedging Abilities

Risk averse investors seek to avoid negatively skewed payoffs, and wish to limit risk exposures (Kumar, 2009)

To understand the relation between DAX and BTC returns: regression analysis (Greene, 2018)

$$r_{\text{BTC},t} = \alpha + \beta r_{\text{DAX},t} + \varepsilon_t,$$

	α	β	R^2
<i>Full sample</i>	0.0045	0.3362	0.0109
<i>2012</i>	0.0047	0.2150	0.0068
<i>2013</i>	0.0171	0.6963	0.0101
<i>2014</i>	-0.0023	-0.0626	0.0006
<i>2015</i>	0.0019	0.1567	0.0070
<i>2016</i>	0.0036	-0.2349	0.0195
<i>2017</i>	0.0111	0.4535	0.0049
<i>2018</i>	-0.0038	0.6822	0.0252
<i>2019</i>	0.0038	-0.3206	0.0046
<i>2020</i>	0.0055	0.7146	0.1417

4 Hedging Abilities

Distinguishing in days with positive/negative signed DAX and BTC returns

2,275 return obs. → DAX: 1,223 (+) and 1,052 (-)
BTC: 1,276 (+) and 999 (-)

Joint occurrence – once unconditioned, once under given sign for DAX return

		DAX+	DAX-	cond. DAX+	cond. DAX-
<i>Full sample</i>	BTC+	0.3081	0.2527	0.5732	0.5466
	BTC-	0.2295	0.2097	0.4268	0.4534
<i>2012</i>	BTC+	0.3110	0.2756	0.5725	0.6034
	BTC-	0.2323	0.1811	0.4275	0.3966
<i>2013</i>	BTC+	0.3715	0.2925	0.6667	0.6607
	BTC-	0.1858	0.1502	0.3333	0.3393
<i>2014</i>	BTC+	0.2262	0.1706	0.4043	0.3874
	BTC-	0.3333	0.2698	0.5957	0.6126
<i>2015</i>	BTC+	0.2964	0.2134	0.5435	0.4696
	BTC-	0.2490	0.2411	0.4565	0.5304
<i>2016</i>	BTC+	0.3294	0.2784	0.6176	0.5966
	BTC-	0.2039	0.1882	0.3824	0.4034
<i>2017</i>	BTC+	0.3571	0.3214	0.6667	0.6923
	BTC-	0.1786	0.1429	0.3333	0.3077
<i>2018</i>	BTC+	0.2470	0.2470	0.5082	0.4806
	BTC-	0.2390	0.2669	0.4918	0.5194
<i>2019</i>	BTC+	0.3108	0.2311	0.5379	0.5472
	BTC-	0.2669	0.1912	0.4621	0.4528
<i>2020</i>	BTC+	0.3228	0.2441	0.6457	0.4882
	BTC-	0.1772	0.2559	0.3543	0.5118

4 Hedging Abilities

Multiple regression analysis

$$r_{\text{BTC},t} = \alpha + \beta_1 r_{\text{DAX},t}^+ + \beta_2 r_{\text{DAX},t}^- + \varepsilon_t.$$

	α	β_1	β_2	R^2
<i>Full sample</i>	0.0063	0.1207	0.5312	0.0131
<i>2012</i>	0.0008	0.6425	-0.2466	0.0198
<i>2013</i>	0.0234	-0.2000	1.6399	0.0178
<i>2014</i>	-0.0029	0.0185	-0.1390	0.0010
<i>2015</i>	0.0026	0.0872	0.2253	0.0076
<i>2016</i>	0.0022	-0.0723	-0.3670	0.0228
<i>2017</i>	0.0086	0.8995	-0.1529	0.0079
<i>2018</i>	-0.0045	0.7822	0.6086	0.0254
<i>2019</i>	0.0037	-0.3026	-0.3380	0.0046
<i>2020</i>	0.0122	0.1686	1.1596	0.1803

(+) Diversification potential of Bitcoin

⇒ improved portfolio performances and quantile risk measures of DAX-BTC portfolios

(–) Hedging capabilities of Bitcoin

⇒ no evidence for Bitcoin as a hedge against stock market downturns

For other periods than reported: no substantially further findings

Researching hedging abilities: consideration of shorter time periods

Structural break in 2020? (pandemic, geopolitical instability)

Time series extension